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Support for solar energy: Examining sense of place and utility-scale development in California

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ABSTRACT

As solar costs have declined PV systems have experienced considerable growth since 2003, especially in China, Japan, Germany, and the U.S. Thus, a more nuanced understanding of a particular public's attitudes toward utility-scale solar development, as it arrives in a market and region, is warranted and will likely be instructive for other areas in the world where this type of development will occur in the near future. Using data collected from a 2013 telephone survey ($N = 594$) from the six Southern Californian counties selected based on existing and proposed solar developments and available suitable land, we examine public attitudes toward solar energy and construction of large-scale solar facilities, testing whether attitudes toward such developments are the result of sense of place and attachment to place. Overall, we have mixed results. Place attachment and sense of place fail to produce significant effects except in terms of perceived positive benefits. That is, respondents interpret the change resulting from large-scale solar development in a positive way insofar as perceived positive economic impacts are positively related to support for nearby large-scale construction.

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1. Introduction

The Intergovernmental Panel on Climate Change (IPCC) contends that “it is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century” [1]. Negative effects of climate change are being observed on a global level in flora and fauna [2], as well as in terrestrial and marine ecosystems [3]. In addition, rising energy prices, declining energy availability, and weakened energy security have led many countries to commit, with varying degrees of enthusiasm, to decreasing their dependence on fossil fuels and instead turn to renewable energy development. With the stark reality that global demand for energy is projected to more than double in the next 40 years and perhaps triple in the next 100 years (Energy Information Agency [4]), it is clear that the need for renewable energy development is ever more critical. In terms of global commitment to renewable energy, the U.S. ranks seventh, with only 2.7% of its energy derived from renewable sources, behind Germany, which ranks first with almost 11 percent of its energy derived from renewable sources, and the entire European Union (27 countries), which ranks second [5]. In the U.S., renewable energy initiatives such as geothermal, wind, solar, hydropower and bioenergy have been around for the better part of the 20th century, with varied impact. However, some technologies, especially wind and solar, are more recently gaining the traction they need in order to become viable alternatives to fossil fuels. In particular, with governmental support for solar R&D initiatives, solar technologies have vastly improved, thereby making solar a more accessible and affordable choice for many.

During the 2008 campaign, candidate Obama pledged to expand domestic energy production, especially renewable energy. His plan was to combine economic growth in a “green” economy. “If I am President, I will invest $15 billion a year in renewable sources of energy to create five million new, green jobs over the next decade—jobs that pay well and can't be outsourced; jobs building solar panels and wind turbines and fuel-efficient cars; jobs that will help us end our dependence on oil from Middle East dictators” [6]. In October of 2012, the Obama Administration made a tangible contribution to that goal when Ken Salazar, Secretary of the Interior, established 17 solar energy zones (SEZ), approximately 285,000 acres of public lands, in six western states (Arizona, California,

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Colorado, Nevada, New Mexico, and Utah). The SEZs are identified as priority areas for utility-scale solar and are established to expedite the permitting process [7]. Since 2009, the U.S. Department of Interior has authorized 18 utility scale solar developments. Clearly the U.S. appears to be setting a path for significant solar development. In fact, the U.S. Energy Information Administration forecasts solar electricity generation to increase by almost ten percent annually through 2035 [8, p. 90].

Solar energy is a promising source of energy to help alleviate the growing dependence on fossil fuel-based energy. Although utility-scale solar electricity generating facilities are not yet widespread in the U.S., both public opinion and the U.S. government support development of utility-scale solar. In particular, studies suggest that a majority of the American public supports renewable energy in general [9–13] and solar energy in particular [14]. Moreover, research demonstrates that Americans are even willing to pay more for clean energy production in order to decrease the production of energy from fossil fuels [14]. Nevertheless, even with widespread and growing support toward solar, development of utility-scale solar is often thwarted due to a variety of obstacles including cost, efficiency, and regulations [15]. The age-old explanation of slow development always seems to be one where blame is placed, often unfairly, on local residents' opposition to said development. However, we wonder about the case of utility-scale solar development.

Analyzing utility-scale solar development and public attitudes toward it are important in the context of global solar facilities growth. In the past decade Europe has led in solar installations but has been leveling off. However, the developing world, especially Asia and China in particular, now lead in new installations and total capacity. In 2013 China added more than eleven gigawatts of grid-tied solar photovoltaic (PV) systems, exceeding the combined growth of the next two countries, Japan and the United States [16]. Developing countries and emerging markets constitute the largest opportunity for growth in utility-scale systems because of the need for power to accommodate economic growth, whereas more established markets and slow growing population are more desirable for distributed systems that provide incremental and manageable additions to the grid [17]. Indeed, as solar costs have declined PV systems have experienced approximately 40 percent growth per annum since 2003 [18,19] while utility-scale concentrating solar power has steadily progressed. For these reasons, a more nuanced understanding of a particular public's attitudes toward utility-scale solar development, especially as it arrives in a market and region, is warranted and will likely be instructive for other areas in the world where this type of development will occur in the near future.

In the first volume, Benjamin K. Sovacool and Paul C. Stern define the scope of *Energy Research & Social Science* as multidimensional in terms of both energy and social science [20,21] and that energy research needs to be relevant to "what actual energy policymakers and businesspersons consider important" ([20], p. 1), considering the human causes, human effects and human understandings of energy phenomena, energy sources, and energy systems, respectively ([21], p. 42). The research presented in this paper moves beyond NIMBY and considers an alternative framework for examining attitudes toward solar energy facilities. Specifically, our study considers whether place protective action, based on the processes of place attachment and place identity, adequately explains opposition to renewable energy initiatives. By understanding the motives behind local support or opposition we hope to provide ways for stakeholders to understand the complexity of public attitudes about a proposed project. That is, we hope stakeholders will be able to mitigate costly opposition and instead, by better siting renewable energy projects, design projects and processes that will yield valuable public support. Thus, this research has both theoretical and practical relevance.

2. Previous research

Public opinion data suggest that a majority of the American public supports solar energy development [9–13,22] and the public is willing to pay more for clean energy production in order to decrease the production of energy from fossil fuels [14]. Moreover, when compared with different types of renewable energy, Americans tend to be more supportive of solar [23,24]. Nevertheless, a major obstacle to renewable energy development, including solar, is the siting process.

Many factors contribute to the success or failure of renewable energy projects including cost, efficiency, and regulations [15]. However, public opposition also proves to be a major obstacle in siting specific projects. Indeed, public opposition has thwarted many renewable energy developments. For example, local residents in the San Luis Valley of Colorado opposed a concentrated solar power (CSP) facility because of the impact it would have on the local ecosystem [25]. This example is not an isolated case; despite widespread support for renewable energy, specific projects are often met with strong opposition [11]. Many times, opposition by a vocal and engaged minority can delay or altogether halt a project. This influence by such a vocal minority is referred to as a "democratic deficit" [9].

Early academic studies of NIMBYism (Not In My Backyard) generally accepted the idea of responses being purely local. Dear [26] defines NIMBYs as "the protectionist attitudes of and oppositional tactics adopted by community groups facing an unwelcome development in their Neighbourhood" (p. 288). Many researchers considered local opposition to be akin to a prisoners' dilemma in which individuals generally supported structures or facilities in the abstract but then opposed them when they were sited or planned to be built in proximity to their homes. This attitude of "free-riding" occurs when individuals assume others will take care of the costs of a certain project while still benefitting from the project [27].

The early studies, however, have drawn a good deal of criticism. Indeed, scholars have found that in some cases the expected explanations did not hold up and that other more complex explanations to opposition prove significant. For example, contrary to NIMBY theory, proximity does not adequately explain opposition [28,29]. Rather, proximity can actually lead to greater support for projects, especially when economically stressed communities will financially benefit from building of some proposed infrastructure [12,30]. As well, the NIMBY explanation suggests that opposition is the result of ignorance or irrationality, but scholars have found that opposition can be both very informed [31,32] and rational [33]. Van der Horst [34] points out that opposition can ebb and flow depending on where in the process a project is. More specifically, opposition tends to be strongest at the beginning of a project (at proposal stage) and weaken as a project's construction process continues, implying that concerns are alleviated as the true impacts of a project are revealed. Also, opposition has been found to be the result of perceived unfairness [35,36] and the negative visual impact of a given structure [37,38]. Therefore, many scholars have urged moving beyond NIMBY explanations.

2.1. Place attachment

While Devine-Wright [39] urges consideration of place attachment in the development of energy infrastructure, the concept is not novel. Geographer Tuan [40] presents an early examination into the notion of attachment to place. What begins as *space* develops into *place* for individuals as they come to know and value places. Place attachment is a collective orientation and describes the process of becoming attached to an environmental setting [41] and this orientation need not be wholly positive. Manzo

[42,43] characterizes place attachment as a positive connection with what is familiar, such as home or neighborhood, and others link place attachment to length of residence [44,45]. For environmental psychologists, place-identity relates to the dimensions of self that develop through interaction with the environment via beliefs, preferences, feelings, values, etc. [46]. When change is proposed to a place, it can be perceived as a "disruption" or "threat" and can be met with action in order to preserve the community or neighborhood to which individuals are closely attached. Threats or disruptions to place attachment can result from development, crime, neighborhood decline, and even natural disasters [47]. Individuals develop a sense of place from the environmental experiences that they accumulate over time and such experiences are usually characterized as positive, but not necessarily so.

Place attachment often has an element of localness due to the fact that individuals who are nearby are more likely to use an area than those who live far away. Thus, people tend to have greater place attachment to the area they settle, relative to those who live elsewhere. As a result, scholars have found that the neighborhood, residential environment, and community is what individuals tend to attach themselves. However, areas that possess value as a national symbol can also garner such place attachment by individuals who live farther away. Moreover, places, and thus place attachment, can vary with regard to scale (e.g. a house, playground, or forest, etc.) and tangibility of an area. Finally, Riger and Lavrakas [48] identify two distinct dimensions of neighborhood attachment: "rootedness" and "bonding," the latter of which also identified as "local bonds" by Taylor et al. [49] and centers on social bonds and also includes length of residence.

Place-attachment is characterized as "positively experienced bonds, sometimes occurring without awareness, that are developed over time from the behavioral, affective, and cognitive ties between individuals and/or groups and their socio-physical environment," [50, p. 337]. Devine-Wright defines the various aspects of place including: location, locale, and sense of place [51]. In his own work considering opposition to wind turbines, Devine-Wright [10] discusses how physical proximity to wind turbines is not a good predictor of public opposition to them; rather, social influence and community perceptions of wind turbines play a larger role in support or opposition to the projects than does physical proximity alone. Therefore, there exist a number of factors that affect one's perception of wind energy, including "physical, contextual, political, socio-economic, social, local and personal aspects" ([10], p. 134).

Many scholars have begun to explore public acceptance of energy facilities in terms of place attachment. In particular, Vorkinn and Riese's [41] study considers both place attachment and demographic variables (gender, age, and income) to explain public acceptance of a major hydropower development in Norway. They find that place attachment explains more of the variance than all the demographic factors combined. More recently scholars have utilized place attachment to understand local acceptance of wind turbines in the UK [10,39,52,53,28] as well as elsewhere [54,55]. Scholars have also used the place attachment framework to examine public acceptance of other energy infrastructure including tidal energy [56] and transmission lines [57]. So far, the place attachment framework has not been considered in terms of large scale solar facilities in the U.S.

Similarly, scholars have utilized place-related symbolic meaning as an explanatory variable for land-use change proposals [50,52,58,59]. These sorts of measures capture the impact of change or a sense of disruption to place attachment for a variety of reasons including human or natural events [47] or changes to an area's legal or symbolic designation [60,61]. For example, Stedman [59] considers place-related symbolic meaning, place attachment, and place satisfaction to explain activism of property owners in opposition of new housing developments in a lakeshore area in northern Wisconsin. Stedman finds that place-related symbolic meaning has a significant positive impact on the dependent variable that is independent of place attachment and place satisfaction. Opposition, as result, is characterized by Stedman as being due to a "lack of fit" between the proposed land-use and the symbolic meaning of place. "This diversity in response suggests that how changes to places are interpreted, rather than the form of change per se, is critical in determining whether the pattern of association between place attachment and acceptance is positive or negative" [52].

Understanding public acceptance to large-scale solar facilities is practically relevant. Public opposition has delayed or altogether halted a variety of energy development including offshore oil drilling, nuclear power, Cape Wind, and high-voltage electric transmission lines. This project considers place attachment and place-related symbolic meaning in terms of public acceptance of large-scale solar facilities in Southern California. We have two goals for this study. First, we hope to address a gap in the literature regarding public attitudes toward large-scale solar development. Second, we hope to demonstrate how the framework of place (e.g. sense of place, place attachment, etc.) can be a worthwhile alternative to the NIMBY framework, especially in terms why people might support (or oppose) energy infrastructure in the context of the U.S.

3. Data

This study used a dual-frame telephone survey methodology, utilizing household Random Digit Dialing (RDD) landline ($n = 5442$) and wireless RDD telephone numbers ($n = 5000$). Both frames were simple random samples of numbers from within six counties in southern California (Inyo, Kern, Riverside, San Bernardino, San Luis Obispo, and Ventura). In fact, these counties were chosen because of their close proximity to proposed, developing, or existing utility-scale solar generation facilities. That is, the goal behind this sampling decision was to collect public opinion data from people who are more likely to have firsthand experience with utility-scale solar facilities sited in their counties. Based on data from the Solar Energy Industries Association,[1] there is a considerable amount of solar development activity occurring in Southern California. By focusing the oversample on respondents who are geographically closer to active utility-scale development, construction, and operation, the survey is able to collect opinions from respondents that are more likely to be based on direct personal experiences with these facilities. Southern California makes for an interesting case study to study solar development. It is viewed as one of the most desirable places to live in the U.S., generally with higher per capita income and higher property values than much of the United States, and it is a region that is very proactive in both regional and local policies.

Calls began 21 March 2013 and continued until 13 June 2013. The Social Science Research Unit (SSRU) at the University of Idaho conducted the surveys and employed a Spanish-language speaking interviewer. Eighty-two interviews were completed in Spanish. The final response rate (AAPOR2[2]) for the two frames combined is 9.7 percent, the final cooperation rate is 27.7 percent, and the final refusal rate is 27.1 percent. Heavy fires with evacuations were

[1] http://www.seia.org/research-resources/major-solar-projects-list.

[2] American Association of Public Opinion Research. 2011. Standard Definitions: Final Disposition of Case Codes and Outcome Rates for Surveys. Available at: http://www.aapor.org/AM/Template.cfm?Section=Standard_Definitions2&Template=/CM/ContentDisplay.cfm&ContentID=3156.

reported in some of the counties in early May while this study was underway. All statistical analyses were conducted using IBM SPSS Statistics, version 22.0 [62].

While the primary purpose of our data project and data collection is to support the development of a GIS based siting tool that includes sociopolitical constraints and public preferences, our survey is also designed to test theories such as place attachment. The GIS-based siting tool assesses proposed alternatives to identify feasible and potentially optimal sites for utility-scale solar development. In order to design this tool, our instrument assesses the value that respondents place on a variety of geographic features and land-types and which of these they would like to see protected from the siting of solar or those that they consider preferable for siting solar.

3.1. Measures

To gauge support for utility-scale solar projects we use the following question, "Suppose the construction of a large solar facility was planned near to where you live. How strongly would you support or oppose its construction?" Answer categories are based on a five-category Likert scale from 1 (strongly oppose) to 5 (strongly support).

Our predictor variables include those that have previously been found to relate significantly to support and opposition to energy facilities and also often standard predictors of environmental and political attitudes include demographics factors, socio-psychological factors, including place attachment, and project related factors. Demographic variables include sex, age, race, education, and urbanicity. With regard to socio-psychological measures we include party identification, belief in the seriousness of climate change, and place attachment.

Place attachment is measured by proxy with length of residency in the area. In addition, we also capture place-related symbolic meanings with five Likert-type items. The five place-related symbolic measures were initially designed and used by Devine-Wright (2011) to reflect the natural beauty of the locality, the presence of a strong community bond, and socio-economic vitality and are as follows: I don't want the landscape of this place to change; this place has a great community of people; this place is a beautiful area; nature is unspoiled in this place; and this place is too quiet—it needs to liven up a bit. All items, excluding length of residency in the area, included a 5-category response format ranging from 1 (strongly agree) to 5 (strongly disagree) with a midpoint of neither agree nor disagree. While we are not certain the direction of the relationship that place attachment will have on degree of support, we expect that it will have a strong and significant impact on support.

Project-related items capture the perceived impacts, both positive and negative, such as jobs, too much traffic, or increased/decreased property values that might result from building a large-scale solar facility nearby, as well as attitudes about the procedural justice of the decision-making process. These items also include Likert-type answer categories ranging from 1 (strongly agree) to 5 (strongly disagree), except for perceived impact on property value, which ranges from 1 (increase greatly) to 5 (decrease greatly) and are included based on previous research that demonstrates their significance in terms of wind siting [52,57,63].

We used a factor analysis using the principal components method with a varimax factor rotation to assess the underlying dimensions of our place-related and interpreting change via project-related measures. Our analyses of the twelve items reveals a four factor structure (Table 1). The first factor, "Good Community," consists of four items explaining 60% of the variance and yields an eigenvalue of 7.0. The four items loading on the first factor capture an underlying positive regard for the community, its

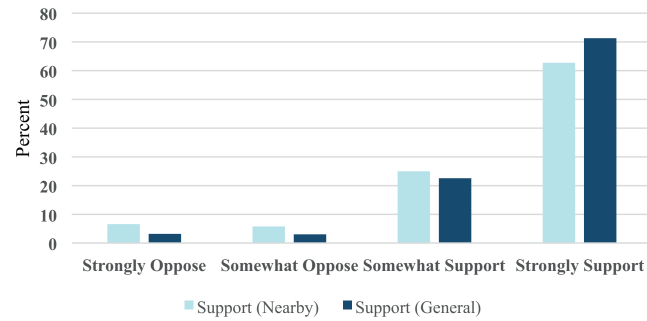

Fig. 1. Degree of support and opposition to large-scale solar development among Southern Californians.

people, and an unwillingness for it to change and are highly correlated with a Cronbach's alpha of 0.65. The second factor, "Positive Impacts—Community," consists of two items explaining 13% of the variance[3] and yields an eigenvalue of 1.0. These two items capture an underlying positive economic benefit from building large-scale solar in terms industrialization and jobs and are also highly correlated with a Cronbach's alpha of 0.76. Factor three, "Positive Impacts—Personal," also consists of two items capturing the positive impact that would result from building a large-scale solar facility nearby but do so more in terms of the personal impact. These two items explain 12% of the variance and yield an eigenvalue of 1.5 and a Cronbach's alpha of 0.5. The fourth factor, "Negative Impacts," captures negative aspects of solar development with three items loading and explaining 11% of the variance with an eigenvalue of 1.0 and low reliability with a Cronbach's alpha of 0.27. Length of residency in the area failed to load on any of the four factors.

4. Results

We now turn to an examination of the public support for large-scale solar development among Southern California residents. For comparison value, we consider two measures of support: One considers support for large-scale solar development nearby to one's home, and the second considers the level of support for large-scale solar construction in the U.S. (thus removing any mention of the facility being built *nearby* to where the respondent lives). In looking at Fig. 1, in Southern Californian there is overwhelming support for solar development for both measures. First, approximately 90% of respondents support solar development near to where they live while only a very small proportion of respondents oppose the construction of large solar facilities near to where they live (10%). Similarly, respondents are overwhelmingly supportive of large-scale solar development in the U.S. with approximately 95% of respondents supporting large-scale solar development in general and only about 5% of respondents opposing large-scale solar construction in the U.S. However, we do see support for large-scale solar development drop when the survey question conveys the facility being built "near" to the respondent and a paired samples *t*-test reveals a statistically reliable difference between the mean level of support for building large-scale solar in the U.S. ($M = 3.64$, $SD = 0.70$) versus the mean level of support for building large-scale solar developments nearby ($M = 3.50$, $SD = 0.82$; $t(550) = 5.86$, $p < 0.001$).

The purpose of our study is to understand whether place attachment and place-related symbolic meaning helps explain support

[3] Several place-related items included in Devine-Wright's (2011) analyses were omitted from ours due to survey constraints. Two of the omitted items would have likely loaded on the second factor and one likely on the first.

Table 1
Rotated component matrix.[a]

	Good community	Positive impacts (Community)	Positive impacts (Personal)	Negative impacts
Place related symbolic meaning				
I don't want the landscape of this place to change	.572	−.318	.084	.154
This place is a great community of people	.741	.125	−.159	.004
This place is a beautiful area	.811	.014	−.108	−.053
Nature is unspoiled in this place	.690	−.062	.214	−.021
Interpretation of change				
The jobs that would be created from building a new large-scale solar facility would be good for this area	.036	.838	.131	.111
The industrialization that would result from building a new large-scale solar facility would be good for this area	−.011	.821	.131	.109
This place is too quiet; it need to liven up a bit	−.025	−.056	.819	.017
What effect will building a large solar facility within view of your property have on its assessed value?	.002	.231	.743	−.049
Citizens do not have enough opportunity to participate in planning how and where a new large-scale solar facility will be built	.041	−.041	−.072	.768
Building a large-scale solar facility nearby will bring too much construction traffic to the area	.236	−.513	.295	.319
Is there a large solar facility currently being proposed for construction in your county?	.040	−.135	−.038	−.696

Extraction method: Principal Component Analysis. *Rotation method*: Varimax with Kaiser Normalization.
[a] Rotation converged in 5 iterations.

for large-scale solar facilities in Southern California. Specifically, we consider support for a facility proposed nearby to where the respondent lives. Using PLUM (ordinal probit), we regress four factors capturing place attachment and project-related aspects such as the perceived positive and negative effects of large-scale solar development. We also include a variety of control variables that are often standard predictors of environmental and political attitudes including demographic variables such as sex, age, race, education, and urbanicity, and socio-psychological measures such as party identification and belief in the seriousness of climate change (our proxy for environmentalism), on our measure of solar support. Again, while we are not certain the direction of the relationship that place attachment will have on degree of support, we expect that its impact will be strong and significant.

The results of our probit estimation are found in Table 2. Several variables demonstrate statistical significance at the 0.05 α level. However, our primary explanatory variable, the factor capturing place attachment, fails to yield a statistically significant impact ($B = -0.04$ and $p = 0.24$).

While place attachment fails to reach statistical significance, several of the project related factors are significant. In particular, the two factors capturing the underlying positive impacts from building large-scale solar in terms of industrialization, jobs, bringing life to the place, and increased property values have strong and positive relationships (Positive Impacts—Community) and (Positive Impacts—Personal). Thus, respondents who are more likely to see the positive impacts resulting from large-scale solar development nearby are more likely to support large-scale solar development ($B = 0.50$ and $p < 0.001$; $B = .31$ and $p < 0.001$, respectively). In contrast, the factor capturing negative impacts fails to reach statistical significance, albeit barely ($p = 0.07$).

Finally, several demographic variables including race and location (rural) demonstrate strong and positive relationships. Those who are white/Caucasian and rural dwellers are more likely to support large-scale solar development than not ($B = 0.59$ and $p < 0.001$; $B = .44$ and $p = 0.004$, respectively). In contrast, in terms of socio-psychological measures, while environmentalism fails to reach statistical significance, party identification demonstrates a strong and negative statistically significant relationship so that Republicans are less likely to support solar than are Democrats ($B = -0.35$ and $p < 0.001$).

Table 2
Probit model of support for solar in Southern California.

Variable	Estimate	Std. Error
Threshold 1	−1.89***	.49
Threshold 2	−1.22**	.48
Threshold 3	−0.40	.48
Sex (male vs. female)	−0.19	.13
Age	0.06	.05
Education	0.08	.05
Race (white vs. non-white)	0.59***	.16
Party identification (republican high)	−0.35***	.10
Seriousness of climate change	0.04	.07
Rural	0.44**	.15
Urban	0.22	.18
Length of residency in the area	−0.10	.06
Good community	−0.04	.07
Positive impacts (Community)	0.50***	.07
Positive impacts (Personal)	0.31***	.08
Negative impacts	0.12	.07
Cox and snell	.28	

* $p \le .05$.
** $p \le .01$.
*** $p \le .001$.

5. Discussion and conclusion

The purpose of this study was to test the impact of place attachment and place-related symbolic meaning on public support and opposition for large-scale solar development. We do so in order to push past the increasingly criticized NIMBY explanation in search for the more nuanced explanation that scholars have been emphasizing in similar and related research. While the NIMBY explanation assumes negative responses and opposition to building infrastructure nearby, whether energy related or not, many scholars who have considered other explanations often uncover a more complex relationship. Indeed, our findings demonstrate a lack of opposition. That is, Southern California residents are overwhelming supportive of large-scale solar. Moreover, the reasons for their support of large-scale solar are related to what is perceived to be positive impacts—jobs, industrialization, an increase in property value, etc. Negative impacts, on the other hand, as well as place attachment and place-related symbolic meaning fail to demonstrate a significant effect.

The strongest predictors in our research are those that are project-related. For example, we explored the factors that capture the perceived impacts, both positive and negative, such as jobs, too much traffic, or increased/decreased property values that might result from building a large-scale solar facility nearby, as well as attitudes about the procedural justice of the decision-making process. Here our findings demonstrate the perceived positive impacts resulting from large-scale solar development are positively related to support for building a large-scale solar facility nearby. Similarly, those who live in rural areas are much more likely to be supportive of large-scale solar development nearby, perhaps reaffirming and underscoring the positive impacts some individuals believe will result from the development of such an infrastructure. Large-scale solar facilities will be built in rural areas. Thus, understanding how individuals who live in these areas perceive such developments is fundamental for stakeholders.

In terms of opposition to large-scale solar development, the strongest predictor, in fact the only predictor demonstrating a negative relationship, is party identification. Scholars of public opinion have long been aware the strong and significant role that predispositions such as values, worldviews, political ideology, and partisan identification, have on opinions. More specifically, one of the key predictors of whether or not you believe climate change is real is partisan identification [63]. Here, our findings support this logic. In terms of solar development in Southern California, it appears to be a partisan issue, which runs in contrast to what Carlisle et al. [22] found when they explored support for solar in five Southwestern states.

Limitations to our study exist. First, the fact that our place-related measures are borrowed from other scholars who have used them in terms of wind in a European context could demonstrate the need for scholars to consider how attachment to place varies with context. That is, place attachment in many European countries, where citizens likely have not only longer histories in villages (centuries of family roots) versus citizens in the Western U.S. whose histories in a particular place are both much younger and less stable, might make a significant difference in how to conceptualize attachment. Moreover, while place attachment might drive support of renewable energy development in the European context, it could be that Europeans possess a more communitarian spirit and thus are more willing to invest long-term in community and place, and renewable energy, versus Americans, who might consider solar development less in terms of a communitarian perspective and more in terms of economic benefit and political predisposition. As such, we have found there are possible limits to the portability of place-related measures.

Second, our study considers large-scale solar in a general sense. That is, our study does not focus on any specific solar development project, proposed or in construction. As scholars have found, public opposition is generally at its highest when projects are proposed and then ebbs after construction is finished [12]. The purpose of our research is to try to understand public attitudes about this development generally rather than any specific site in an area where the probability of some solar development is high and not hypothetical. Moreover, many of the solar facilities that are proposed, under development, or already operating in this region are small (not utility-scale) and thus many people will not have direct knowledge of these specific installations by name. However, what they should have knowledge of, we believe, is that solar development in Southern California (and perhaps the U.S. Southwest) has arrived. Perhaps by considering and discussing specific solar developments with respondents in a more local case study, we might see similar effects. Several studies show that place attachment is a strong predictor of attitudes toward energy-related infrastructure [41,50,56]. However, while these studies show the strong relationship between place attachment and a specific development, they do so in a localized area (e.g. town or village). Our study, in contrast, is more concerned with attitudes about large-scale solar development in general and in a much broader geographic area. Southern California (and the U.S. Southwest) has recently experienced significant activity with regard to large-scale solar development.

Finally, while not included in our current analyses, we consider it important to consider different geopolitical and geo-spatial areas and assess whether support differs based on characteristics related to these. While we have not done so here, our data will allow us to disaggregate our Southern California sample into five different counties, all with varying levels of solar development. We hope to explore our model in terms of different geo-political and geospatial contexts (including buffer zones and visibility of structure) as well as to assess the role that variation in solar development based on these different contexts has, so that we might uncover variation in the impact of our predictors. As such, perhaps this sort of analyses will demonstrate that place attachment and place-related symbolic meaning proves significant in particular contexts but not others.

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